Wandering albatrosses ride infrasonic waves over large geographic scales

Samantha Patrick[1], Natasha Gillies[1], Lucía Martín López[1], Olivier Den Ouden[2], Jelle Assink[2], Mathieu Basille[3], Thomas Clay[1], Susana Clusella-Trullas[4], Rocío Joo[3], Mario Zampolli[5], Jeffrey Zeyl[4] & Henri Weimerskirch[6]

1.University of Liverpool, 2. Royal Netherlands Meteorological Institute KNMI, 3.University of Florida, 4.Stellenbosch University, 5. CTBTO Preparatory Commission, 6.CEBC-CNRS
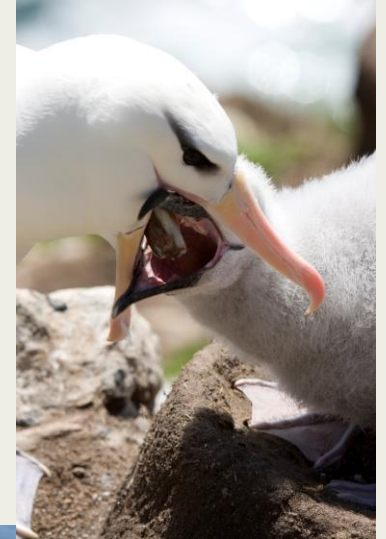
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Samantha Patrick, Natasha Gillies, Lucía Martín López, Olivier Den Ouden, Jelle Assink, Mathieu Basille, Thomas Clay, Susana Clusella-Trullas, Rocío Joo, Mario Zampolli, Jeffrey Zeyl & Henri Weimerskirch

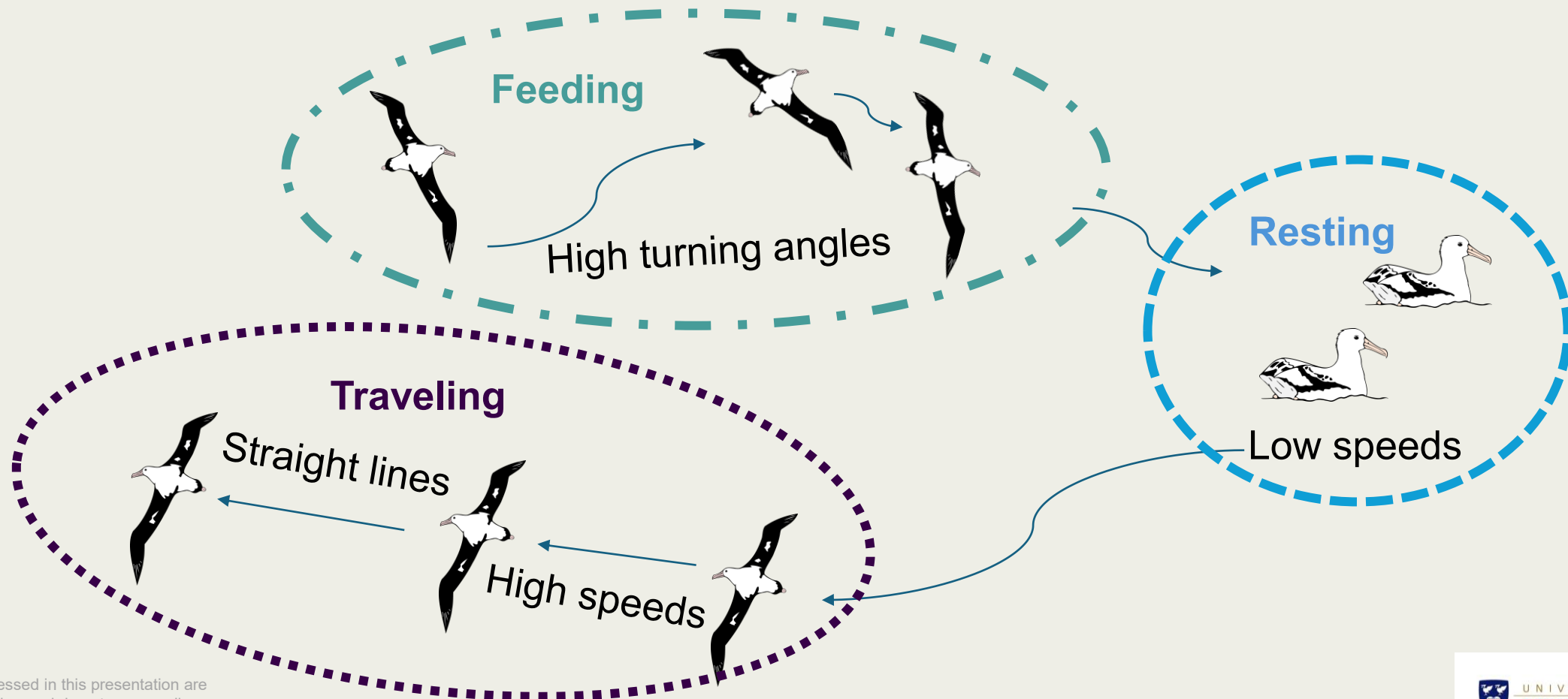## Introduction: Seabirds – the ultimate globe-trotters

- Long-lived, mainly monogamous

- Slow maturity

- Reliant on land to breed

- Cover vast distances

- Live in areas with few obvious cues for navigating

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Introduction: Seabirds – foraging behaviour

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Introduction: Seabirds – the ultimate globe-trotters

- How do birds know where to go?

  - They need information over different scales

    - Short distances - How to find food in localised areas?

    - Medium distances – How to find profitable patches of food?

    - Large distances – How to find and travel to distant areas?

  - And how do they minimise the costs of getting there?

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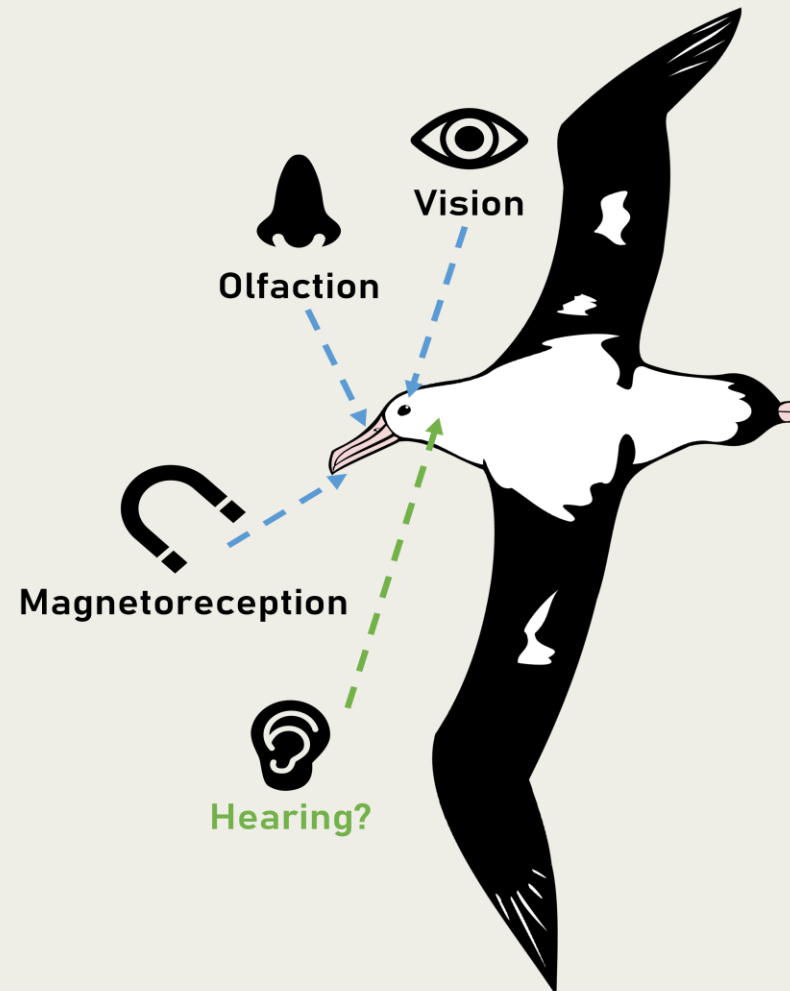
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Introduction: Seabirds – the ultimate globe-trotters

- Wandering albatross

  - Largest seabird (up to 12kg)

  - Hugely wide ranging

  - Highly endangered

  - Rely heavily on wind to minimise the costs of flight

  - Use wind and waves → soaring

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Introduction: What do we know about navigation so far?

- How do they find their way across a seemingly featureless ocean?

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Introduction: What do we know about navigation so far?
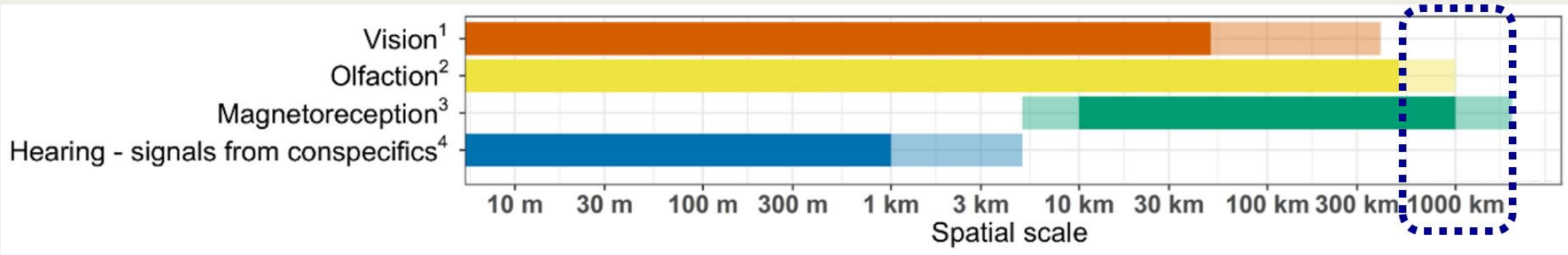
- Dynamic short range → olfaction, vision, hearing

- Fixed long range cues → magnetoreception

Lack of dynamic long-range cues

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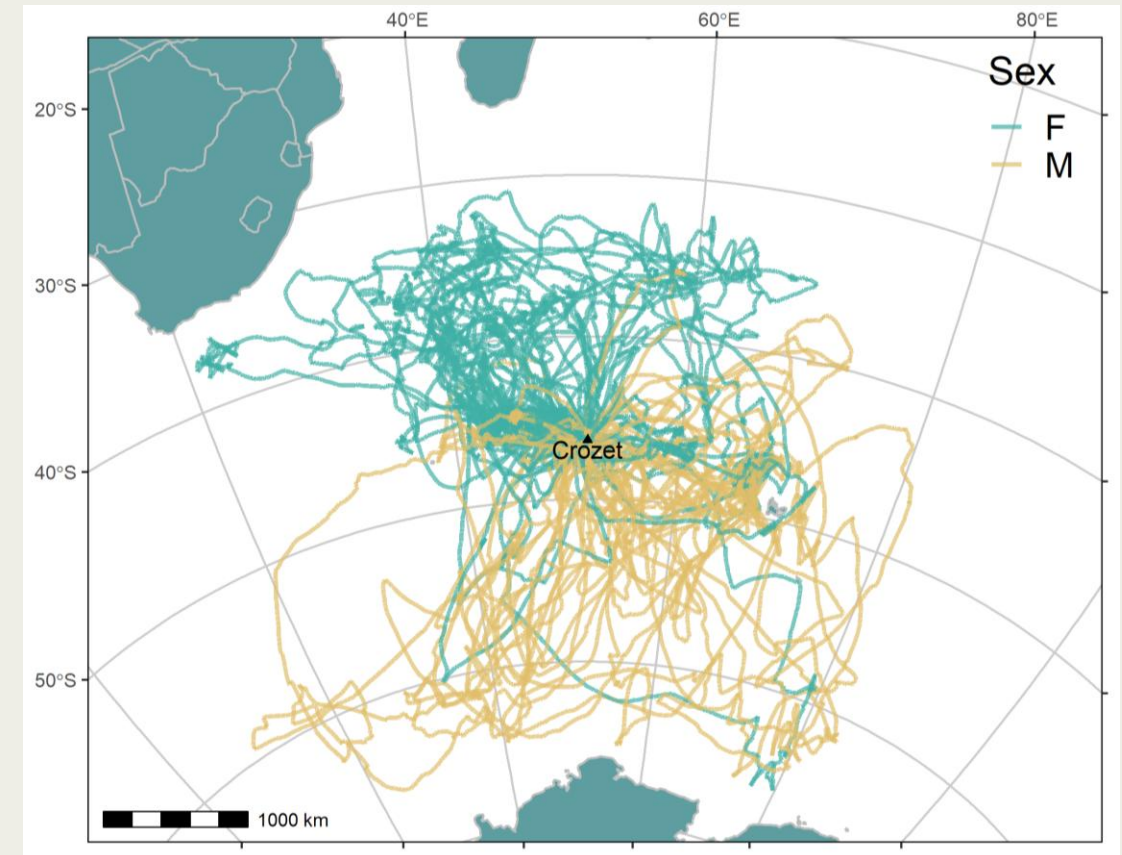
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Introduction: Ocean movement relies on long-range, dynamic cues

- Why might infrasound be important?

  - Identify land → breeding colonies and coastal feeding areas

  - Identify optimal weather conditions → windy and wavy

  - Identify upwelling zones → highly productive

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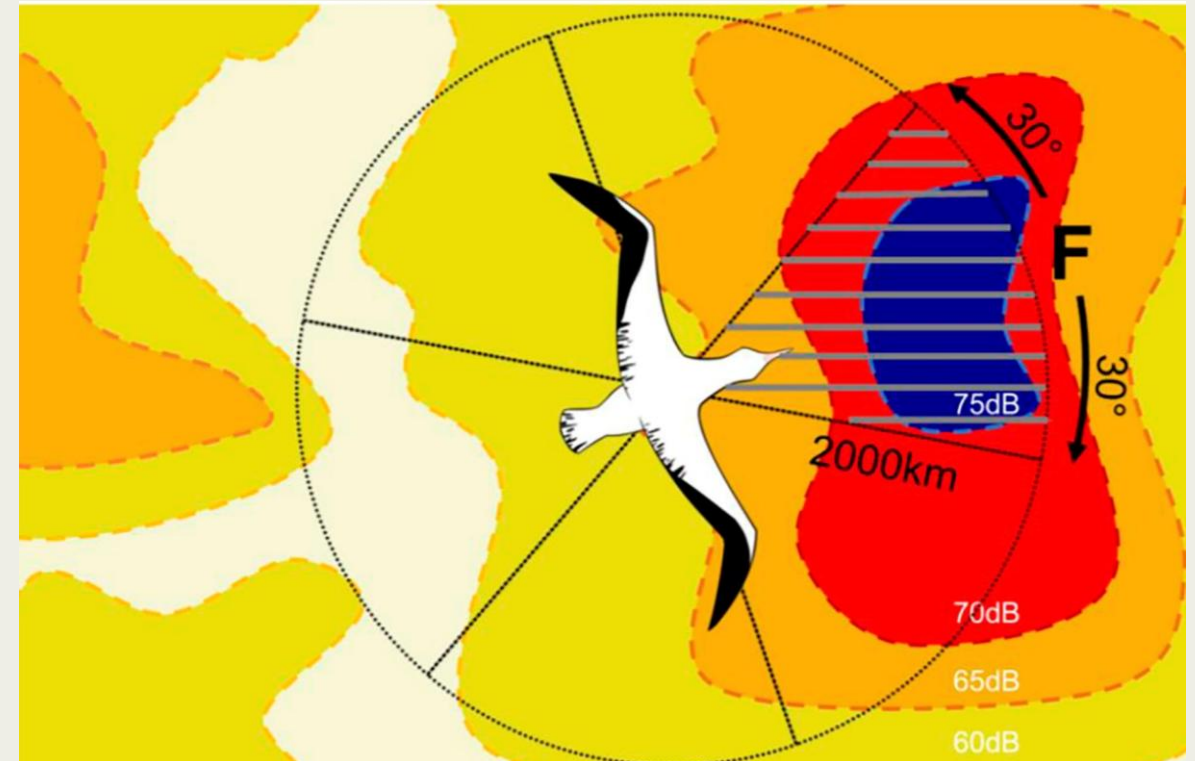**Wandering albatrosses ride infrasonic waves over large geographic scales**
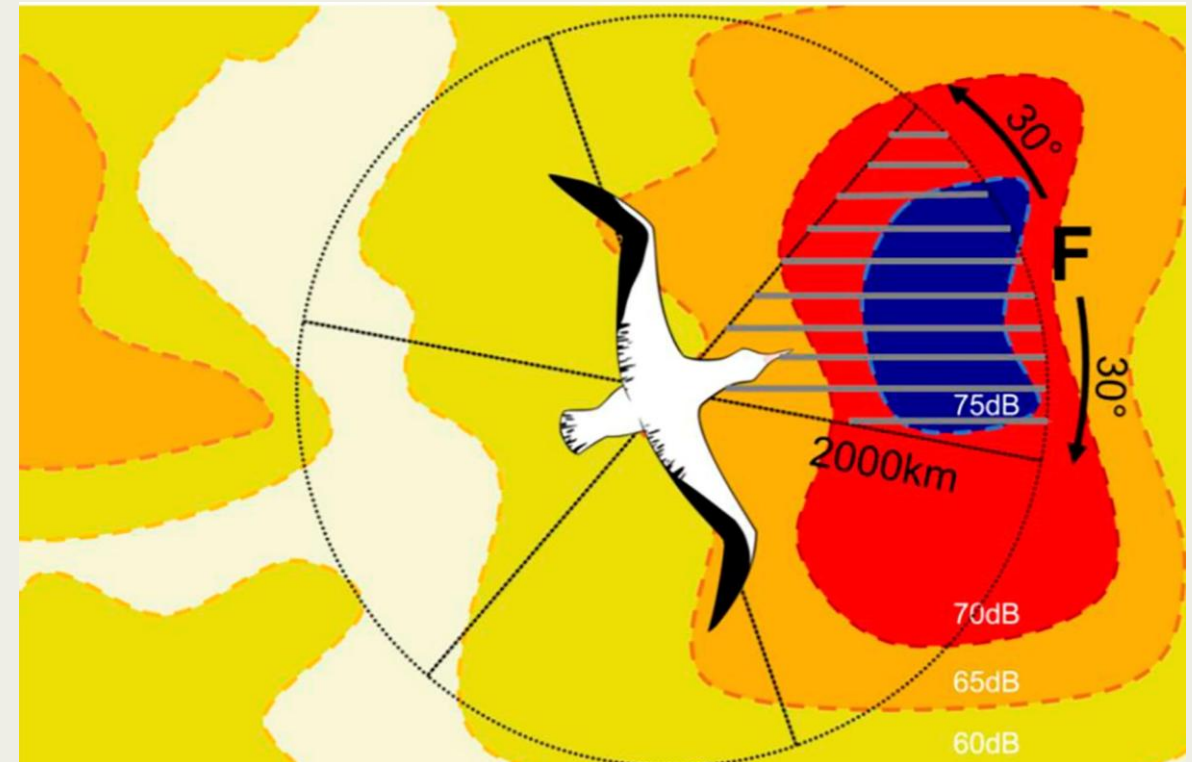
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Introduction: Ocean movement relies on long-range, dynamic cues

Marine habitats → microbarom infrasound (0.06 to 1 Hz)

Microbaroms associated with colliding waves

→ generated by strong winds and storms

→ potential source of:

-   long-range weather information
-   profitable areas
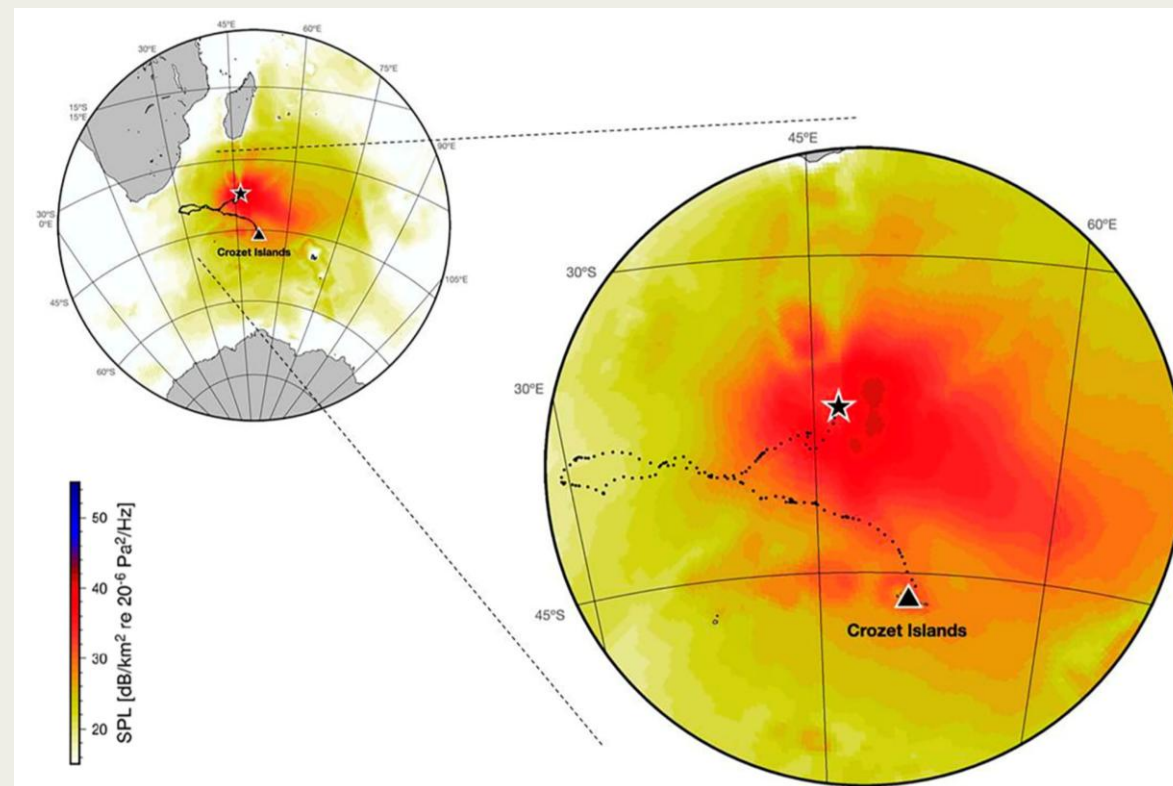
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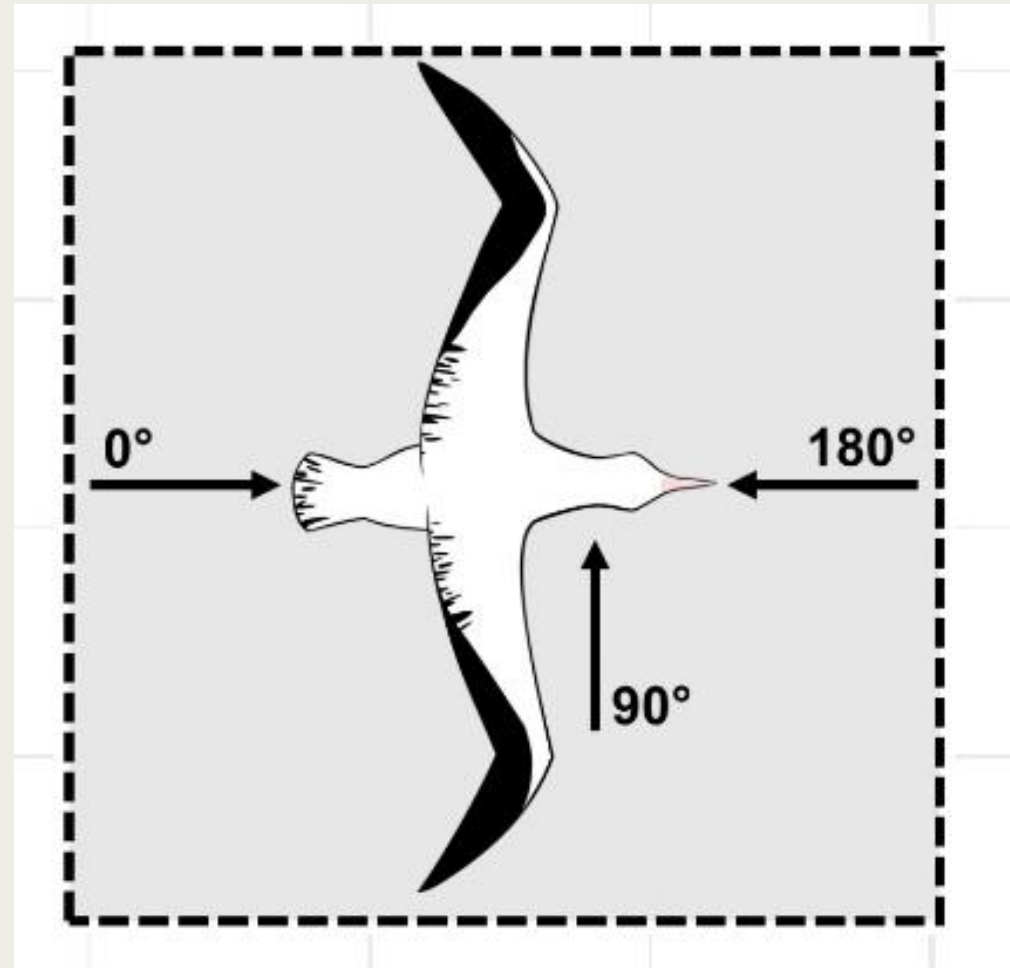# Wandering albatrosses ride infrasonic waves over large geographic scales

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Methods: Data collection and analysis

- 89 albatross with GPS during foraging trips

- Adapted GPS trackers

- Deployed and recovered when bird on nest

- Measure behaviour every 15 mins while at-sea foraging

- Travelling sections identified by rapid, straight flight

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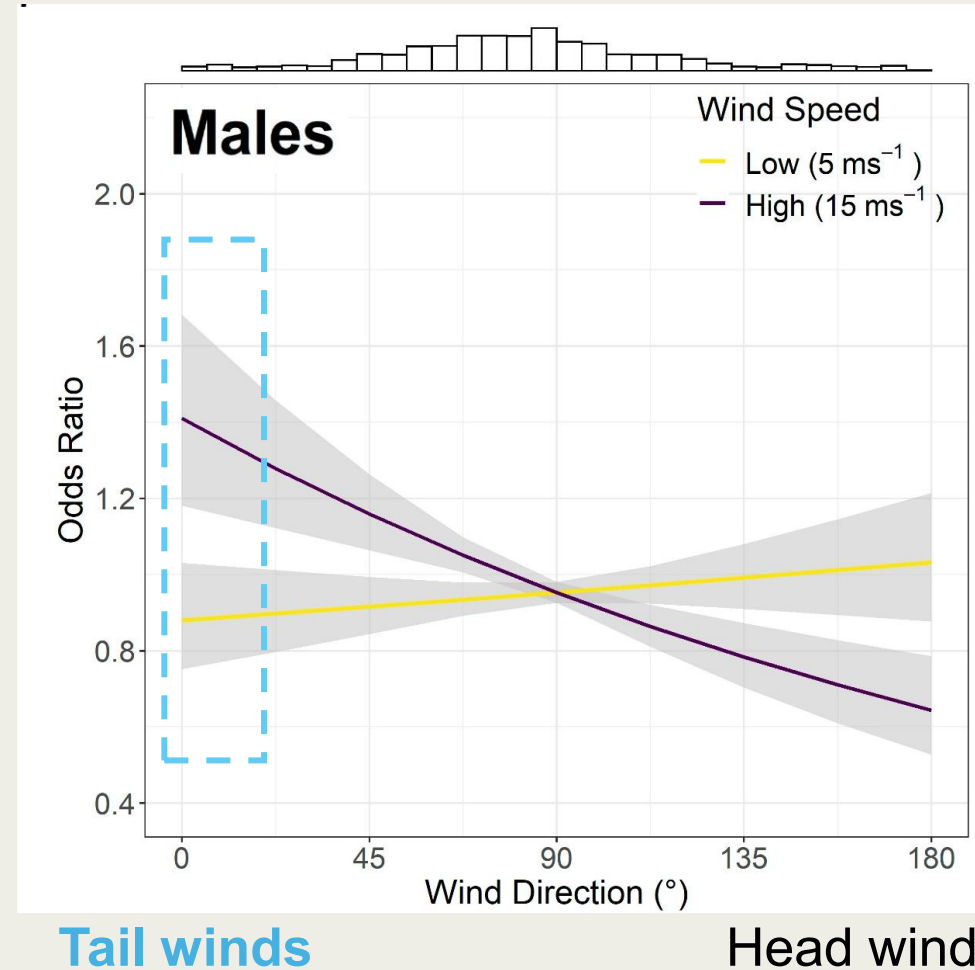
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Methods: Data collection and analysis

- Microbarom soundscape maps → bird experiences in space and time

- ECMWF wind data → speed and direction of wind

- Start of directed flight = decision point

- Created six segments around the bird

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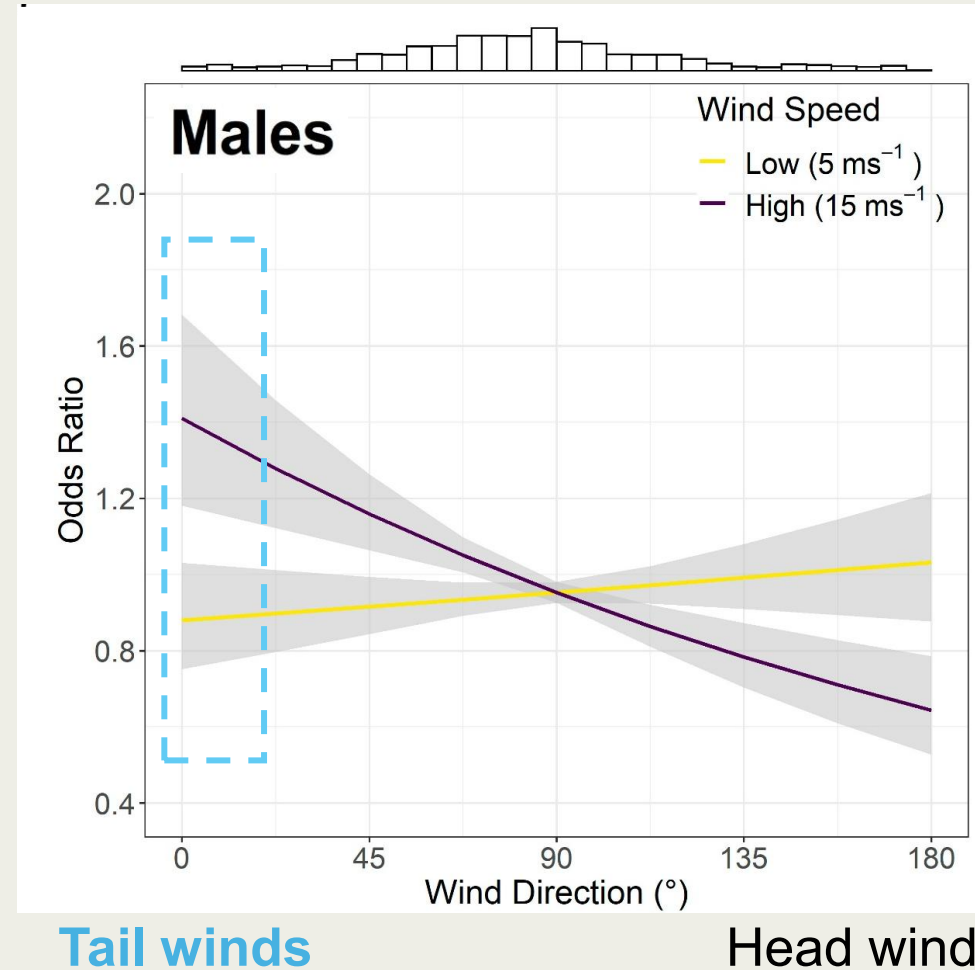**Wandering albatrosses ride infrasonic waves over large geographic scales**

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Methods: Data collection and analysis

- Radius of 2,000 km (captures 95% of the microbarom signal)

- Integrated infrasound over each segment

- Compared conditions within them

- Do birds choose segments based on infrasound and wind?

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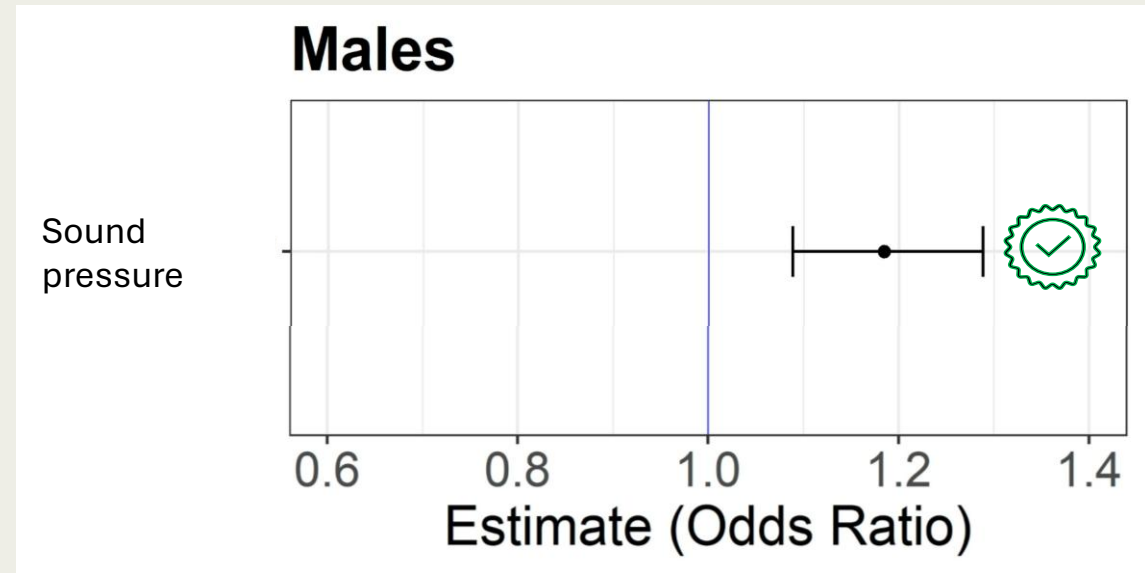# Wandering albatrosses ride infrasonic waves over large geographic scales

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Results: Albatross movement is linked wind

Tail winds
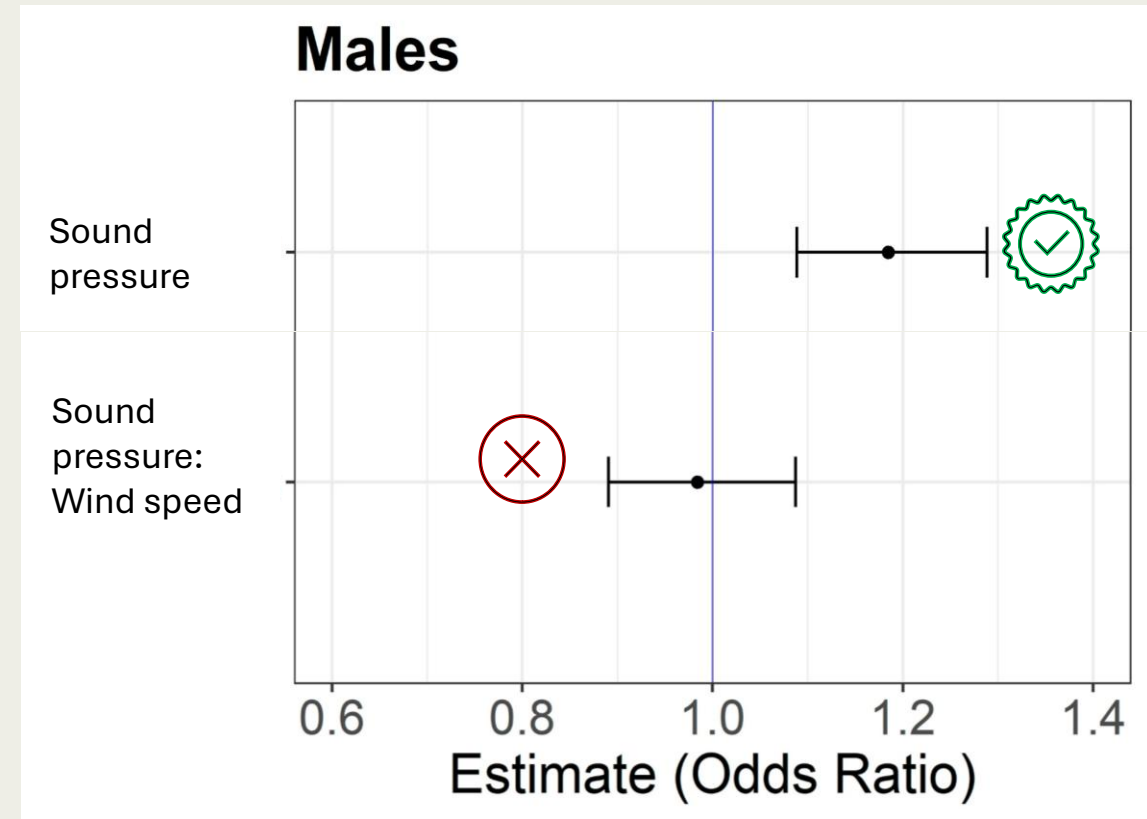
Head winds

Cross winds

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Results: Albatross movement is linked wind

- Patterns similar in males and females

- **Birds chose segments with tail winds**

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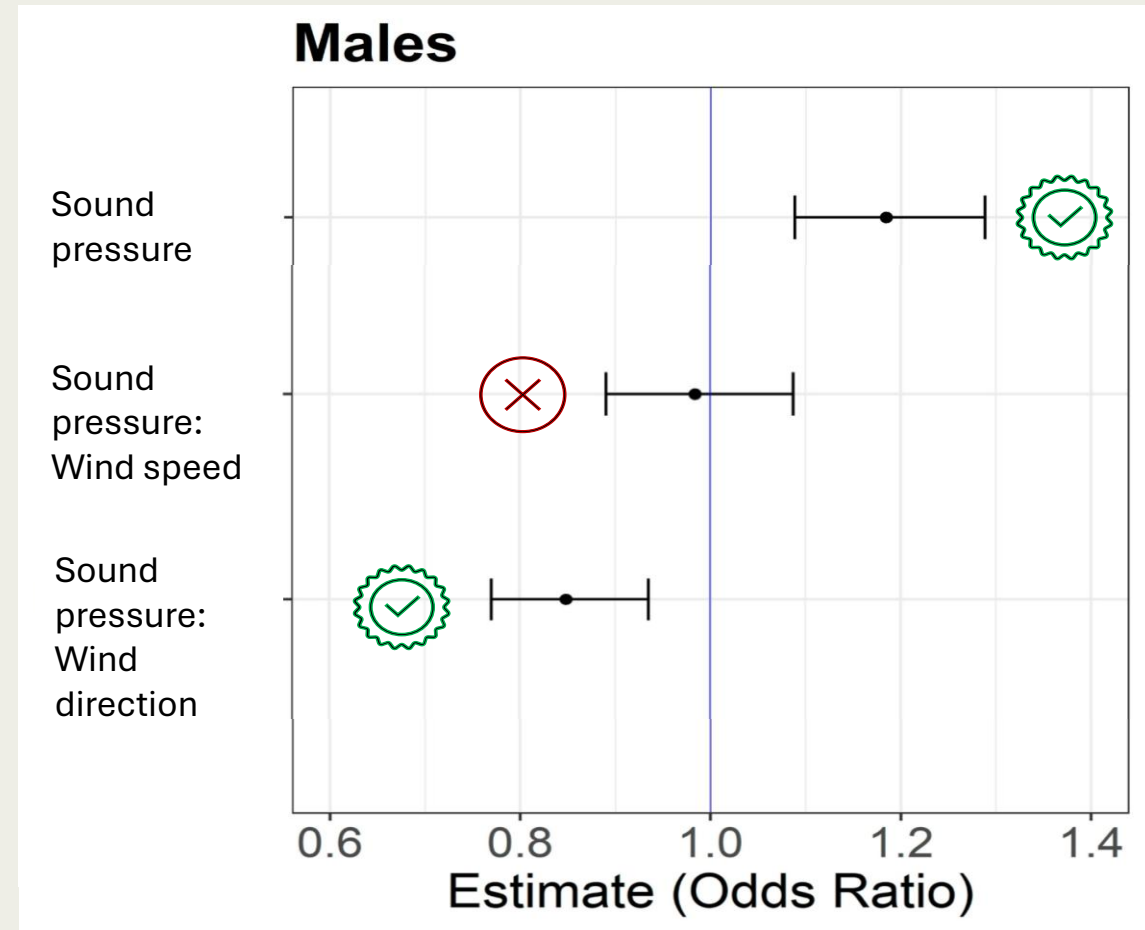
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Results: Albatross movement is linked wind

- Patterns similar in males and females

- **Birds chose segments with tail winds**

- **Most important at high wind speeds**

Tail winds   Head winds

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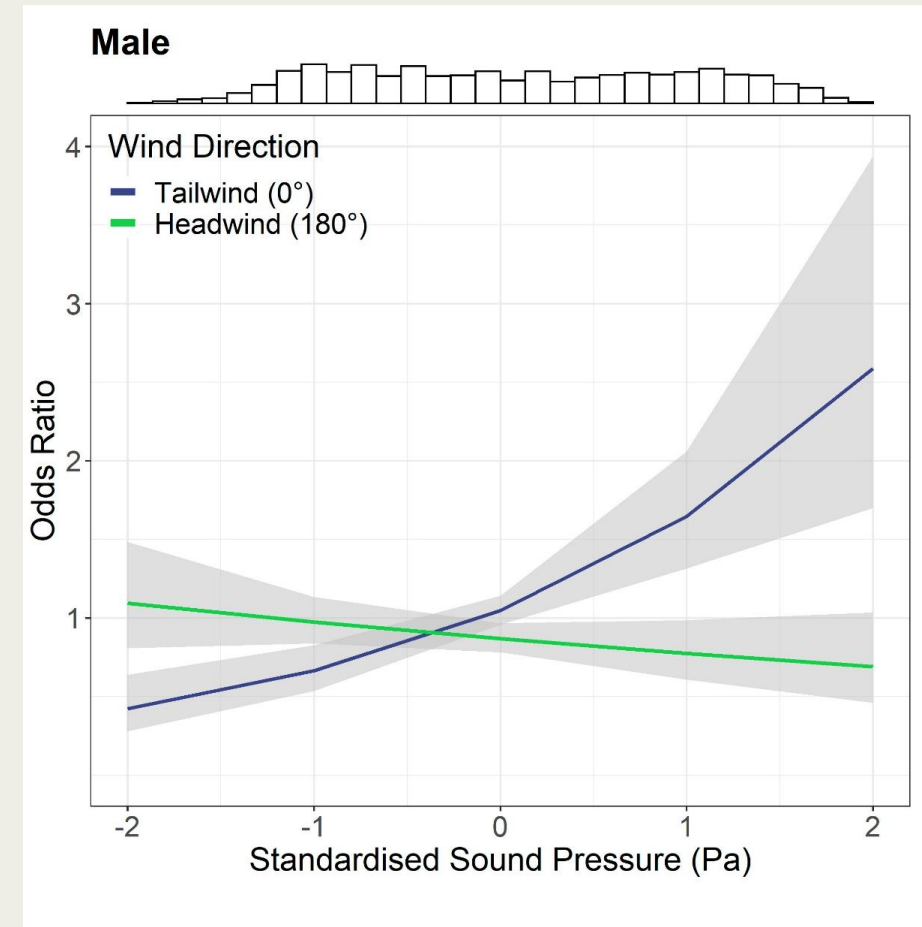
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Results: Albatross movement is linked to infrasound signals

Sound pressure ↑

Choosing segment ↑

Birds move towards areas of higher infrasound

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Results: Albatross movement is linked to infrasound signals

Wind speed

Choosing segment

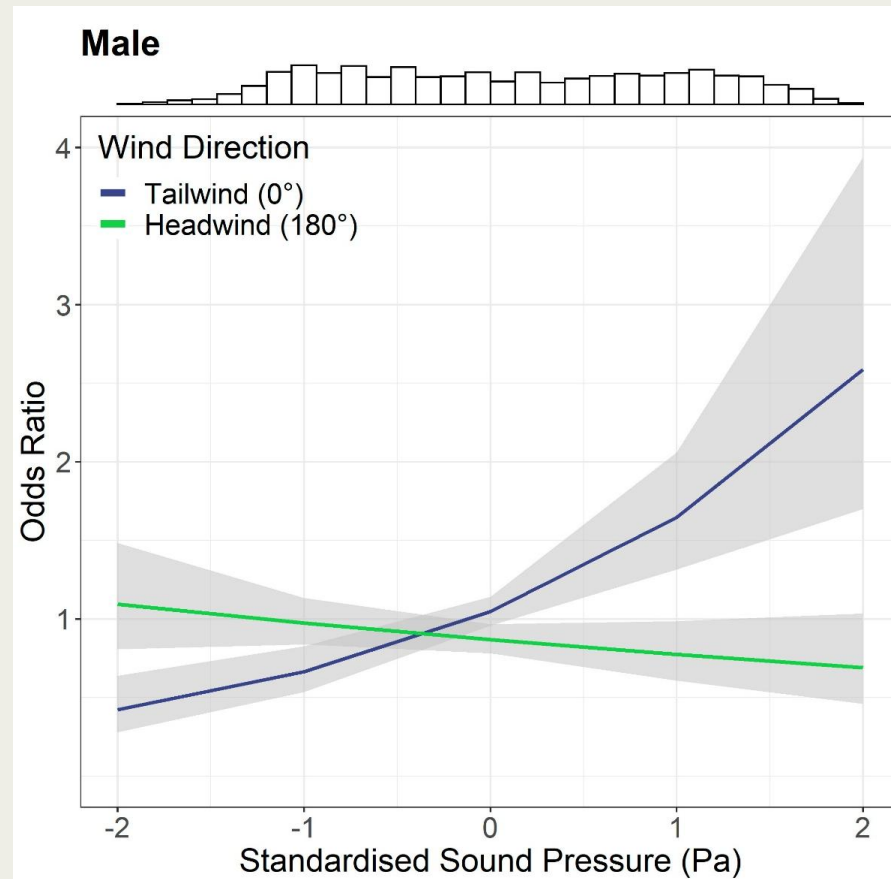**Wind speed does not affect selection for infrasound**

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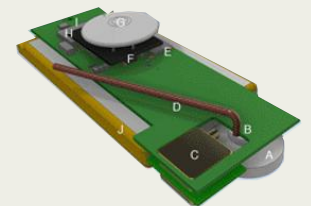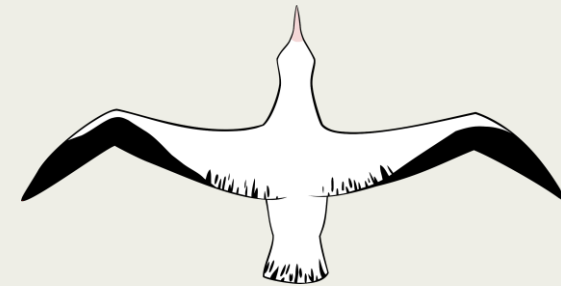
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Results: Albatross movement is linked to infrasound signals

Strong interaction between wind direction and infrasound level

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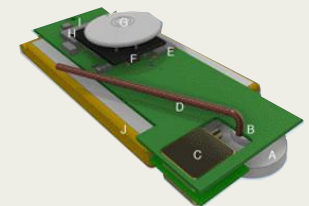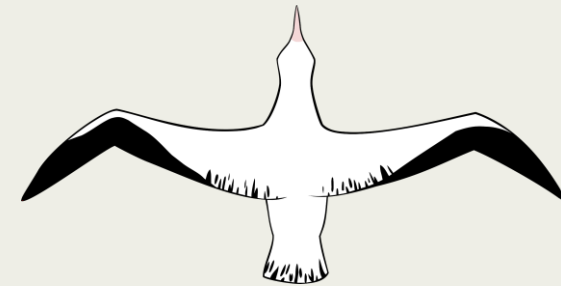**Wandering albatrosses ride infrasonic waves over large geographic scales**

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Results: Albatross movement is linked to infrasound signals

Tailwinds

Sound pressure

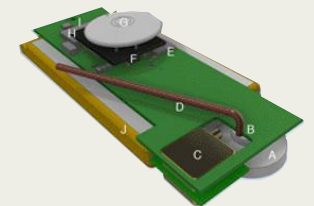Choosing segment

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Results: Albatross movement is linked to infrasound signals

Tailwinds

Sound pressure

Choosing segment

Headwinds

Sound pressure

Choosing segment

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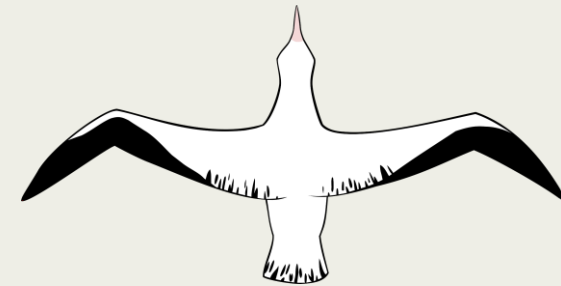**Wandering albatrosses ride infrasonic waves over large geographic scales**
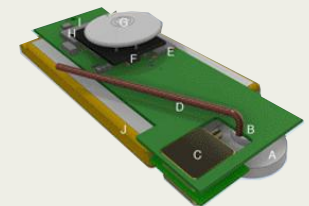
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Conclusions: Take home messages

1. **Birds respond to infrasound**

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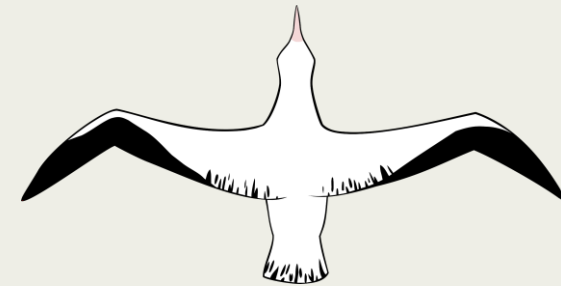
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Conclusions: Take home messages

1. **Birds respond to infrasound**

2. **Infrasound may be a long-distance cue for movement**

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Conclusions: Take home messages

1. **Birds respond to infrasound**

2. **Infrasound may be a long-distance cue for movement**

3. **Wind direction is crucial**

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Conclusions: Take home messages

1. **Birds respond to infrasound**

2. **Infrasound may be a long-distance cue for movement**

3. **Wind direction is crucial**

4. **This is just the start of understanding the importance of infrasound for animal navigation**

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